

38. (Amended) The planar motor of claim 37, wherein the adjustment information includes current adjustment information.

42. (Amended) A wafer on which an image is formed by the lithography system of claim 40.

REMARKS

By this Amendment, Applicant has canceled claims 4, 21, and 34 without prejudice or disclaimer of the subject matter thereof and amended claims 1, 3, 6, 9-12, 15-20, 23, 29, 32, 33, 35, 37, 38, and 42. Accordingly, claims 1-3, 5-20, 22-33, and 35-42 are currently pending in the application. Claims 1, 12, 18, 29, and 32 are independent claims.

Submitted herewith is an Information Disclosure Statement. Applicant respectfully requests that the Examiner consider the document listed in the Form PTO 1449 and indicate that it was considered by making appropriate notations on the form and returning a copy thereof to Applicant.

By this Amendment, Applicant has amended the specification to correct inadvertent errors of a typographical or clerical nature. These amendments do not introduce any new matter into the specification.

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By this Amendment, Applicant has amended claims 6, 9-11, 16, 17, and 42 as suggested by the Examiner in paragraph 2 of the Office Action. Accordingly, Applicant respectfully requests that the Examiner withdraw the claim objections.

The Examiner rejected claims 18-28 and 30-41 under 35 U.S.C. § 112, second paragraph, as being indefinite. See Office Action, paragraph 4. Applicant respectfully traverses this rejection under 35 U.S.C. § 112, second paragraph, because one of ordinary skill in the art would readily determine the scope of the claims. See M.P.E.P. § 2173.02 (8th ed. 2001).

On line 8, claim 18 recites "a magnet array adjacent a portion of the coil array." Accordingly, the recitation "the portion of the coil array" later in claim 18 as well as in claims 20, 22-24, and 26-28 refers to the portion to which the magnet array is adjacent.

Regarding claim 32, the recitation "information related to resultant torques" refers to any information related to the resultant torques. For example, the information may include current or any other parameters related to the resultant torques. In addition, both the phrases "between the first member and the second member" and "generated by the driving force" recited in claim 32 modify the "resultant torques."

As evident from these explanations, one of ordinary skill in the art would readily determine the scope of claims 18-28 and 30-41. Accordingly, Applicant respectfully requests that the Examiner withdraw the rejection under 35 U.S.C. § 112, second paragraph.

In the Office Action, the Examiner rejected claims 1-9, 12-16 and 18-42 under 35 U.S.C. § 103(a) as being unpatentable over Markle (U.S. Patent No. 6,072,251) in view

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of Galburt (U.S. Patent No. 4,952,858) and loi et al. (Japanese Publication No. 3-213,500); rejected claims 10, 11, and 17 under 35 U.S.C. § 103(a) as being unpatentable over Markle in view of Galburt and loi et al. and further in view of so-called "common knowledge;" rejected claims 32-36 and 39-42 under 35 U.S.C. § 103(a) as being unpatentable over Galburt in view of loi et al.; and rejected claims 37 and 38 under 35 U.S.C. § 103(a) as being unpatentable over Galburt in view of loi et al. and further in view of Masanori et al. (Japanese Publication No. 07-131,966).

Applicant respectfully traverses the rejection under § 103(a) because the Examiner has failed to establish a *prima facie* case of obviousness. To establish a *prima facie* case of obviousness under 35 U.S.C. §103(a), each of three requirements must be met. First, the references, taken alone or combined, must teach or suggest each and every element recited in the claims. See M.P.E.P. § 2143.03 (8th ed. 2001). Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to combine the references in a manner resulting in the claimed invention. Third, a reasonable expectation of success must exist. Moreover, each of these requirements must "be found in the prior art, and not be based on applicant's disclosure." M.P.E.P. § 2143 (8th ed. 2001).

The cited references fail to disclose or suggest all of the elements recited in the claims. For example, none of the cited references discloses or suggests a method for controlling a planar electric motor including, among other things, "determining current adjustments to compensate for the resultant torques such that torques about the first,

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second, and third directions become desired values while the forces in the first, second, and third directions remain the same,” as recited in independent claim 1.

The Examiner admits that Markle fails to disclose or suggest at least this recited feature. See Office Action, page 4. Likewise, neither Galburt nor loi et al. discloses or suggests at least this recited feature. As shown in Fig. 1, Galburt discloses a monolithic stage 10 and an X-Y sub-stage 12. The device of Galburt includes four flat coil actuators 36 provided for movements of the monolithic stage 10 in three degrees of freedom and four voice coil type focus actuators 46 provided for movements of the monolithic stage 10 in an additional three degrees of freedom. See col. 3, lines 2-44. To position the monolithic stage 10, Galburt discloses comparing a sensed position of the monolithic stage 10 with a computer commanded position and feeding the resultant error back to the actuators. See col. 4, line 62 through col. 5, lines 27 and Fig. 2. However, Galburt fails to disclose or suggest that the resultant error is determined “such that torques about the first, second, and third directions become desired values while the forces in the first, second, and third directions remain the same.”

loi et al. discloses a device producing a gravity-free state. The device of loi et al. includes an active drive mechanism 2 and a sensor 3 arranged to detect forces of X-Z axes and torque around X-Z axes. See English Abstract. loi et al. further discloses that “feedback control is made on the active drive mechanism 2 so that a force and torque detected by the sensor 3 are balanced with the gravity of the test piece 4.” English Abstract. However, loi et al. fails to disclose or suggest that the feedback control determines “current adjustments to compensate for the resultant torques such that

torques about the first, second, and third directions become desired values while the forces in the first, second, and third directions remain the same.”

Accordingly, none of the cited references discloses or suggests at least “determining current adjustments to compensate for the resultant torques such that torques about the first, second, and third directions become desired values while the forces in the first, second, and third directions remain the same.” For at least this reason, the Examiner has failed to establish a *prima facie* case of obviousness regarding independent claim 1. For a similar reason, the Examiner also has failed to establish a *prima facie* case of obviousness regarding independent claims 12, 18, 29, and 32. Regarding independent claim 32, none of the cited references discloses or suggests a planar motor including, among other things, “the controller determining adjustment information to compensate for the resultant torques such that torques about the first, second, and third directions become desired values while the driving force remains the same.”

Accordingly, independent claims 1, 12, 18, 29, and 32 are in condition for allowance. Claims 2, 3, 5-11, 13-17, 19, 20, 22-28, 30, 31, 33, 35-42 are also in condition for allowance at least by virtue of their dependency from their respective allowable independent claims.

In addition, Applicant respectfully traverses the Examiner’s conclusory assertion regarding claims 3 and 20. The Examiner asserted that the “Markle’s and Galburt’s coils would necessarily be energized by sinusoidal, square or triangular current waveforms.” Office Action, paragraph 5. This conclusory assertion, however, fails to

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establish a *prima facie* case of obviousness because it is not supported by any evidence, regardless of whether the Examiner is relying on inherency or common knowledge.

If relying on inherency, the Examiner has failed to meet the required burden. See M.P.E.P. § 2112 (8th ed. 2001). First, the Examiner has failed to produce a basis in fact or technical reason why the coils of Markle or Galburt must necessarily be energized by “sinusoidal, triangular or square current waveforms.” Moreover, the Examiner also has failed to explain why a person of ordinary skill in the art would have so recognized the waveforms utilized for the coils of Markle or Galburt. If the Examiner is relying on inherency and maintains the rejection of claims 3 and 20 in the next communication, Applicant respectfully requests that the Examiner supply evidence supporting the Examiner’s position that the coils of Markle or Galburt must necessarily be energized by “sinusoidal, triangular or square current waveforms.”

If the Examiner is relying on common knowledge, the Examiner also has failed to establish a *prima facie* case of obviousness. First, the Examiner has failed to produce any evidence that “sinusoidal, triangular or square current waveforms” applied in coils of a planar electric motor are common knowledge. Moreover, the Examiner has failed to set forth any motivation whatsoever for utilizing “sinusoidal, triangular or square current waveforms” in the coils of Markle or Galburt. If the Examiner is relying on common knowledge and maintains the rejection of claims 3 and 20 in the next communication, Applicant respectfully requests that the Examiner (1) supply the appropriate motivation for utilizing “sinusoidal, triangular or square current waveforms” in the coils of Markle or

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Galburt and (2) supply evidence, either in the form of an affidavit of personal knowledge or a reference, to support his position in accordance with the provisions of M.P.E.P. § 2144.03 (8th ed. 2001).

Finally, Applicant respectfully traverses the Examiner's assertion of common knowledge regarding claims 10, 11, and 17. The Examiner asserted that "[c]hoice of 12 or 16 or more coils would involve ordinary engineering design since the number of coils would depend upon the particular size of the apparatus and intended application." Office Action, page 6. This conclusory assertion fails to establish a *prima facie* case of obviousness. First, the Examiner has failed to produce any evidence that the use of either twelve or more coils or sixteen or more coils in a coil array of a planar electric motor is common knowledge. Furthermore, the Examiner has failed to set forth an appropriate motivation for using either twelve or more coils or sixteen or more coils in Markle or Galburt. The Examiner's assertion fails to explain why "the size of the apparatus and intended application" would require either twelve or more coils or sixteen or more coils in Markle or Galburt. If the Examiner maintains the rejection of claims 10, 11, and 17 in the next communication, Applicant respectfully requests that the Examiner (1) supply an appropriate motivation for the hypothetical modification of Markle or Galburt and (2) supply evidence, either in the form of an affidavit of personal knowledge or a reference, to support his position in accordance with the provisions of M.P.E.P. § 2144.03 (8th ed. 2001).

In view of the foregoing remarks, Applicant respectfully requests the reconsideration of this application and the timely allowance of the pending claims.

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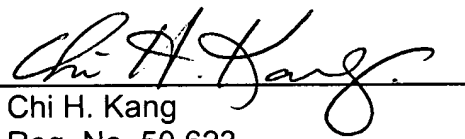
Attached hereto is a marked-up version of the changes made to the specification and claims by this Amendment. The attachment is captioned "**APPENDIX TO AMENDMENT OF FEBRUARY 24, 2003.**" Deletions appear as normal text surrounded by [] and additions appear as underlined text.

Please grant any extensions of time required to enter this response and charge any additional required fees to our Deposit Account No. 06-0916.

Respectfully submitted,

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Dated: February 24, 2003

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APPENDIX TO AMENDMENT OF FEBRUARY 24, 2003

Amendments to the Specification:

Page 3, the paragraph beginning on line 13:

(Amended) The controlling method of the invention is achieved by the interaction of current in the coil and a magnetic field associated with the magnet. The method for controlling a planar electric motor having a [magnetiv] magnet array and a coil array for positioning in six degrees of freedom, includes (1) determining the currents to be applied to the coils to generate forces between the magnet array and the coil array in [a] first (X), second (Y), and third (Z) directions, (2) determining a resultant torque about the first, second, and third directions between the magnet array and the coil array generated by the forces generated by the determined currents; (3) determining current adjustments to compensate for or cancel out the resultant torque; and (4) applying a sum of the determined currents and determined current adjustments to the coils to interact with the magnetic fields of the magnet array.

Page 8, the paragraph beginning on line 29 and bridging pages 8 and 9:

(Amended) As shown in **FIG. 1**, each coil **26** in the coil array **22** has approximately the same shape and size. Although the coils **26** having approximately the same shape and size are preferred, the coils of the coil array **22** may have varying shapes and/or sizes. Each coil **26** preferably covers as much of an area of one coil period in both the X and Y directions as possible in order to maximize the force generated from the interaction between the magnet array **24** and the coil array **[26] 22**

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and thus minimizes the coil power input necessary to achieve a desired amount of force. A rectangular profile of the coil **26** maximizes the area occupied by each coil **26** within the area defined by the coil periods **28, 30** and thus is preferred. As is evident, when the periods **28** and **30** are approximately equal, the profile of the coil **26** approximates a square.

Page 16, the paragraph beginning on line 30 and bridging pages 16 and 17:

(Amended) The current commutation scheme is applied to the coils within the magnetic field of the magnets of the magnet array **[22] 24**. These are referred to as the active coils and include coils which are only partially within the magnetic field of the magnets of the magnet array **[22] 24**. The current supplied through the active coils interact with the magnetic field of the magnet array **24** to generate a force between the magnet and coil arrays **[22, 24] 24, 22**. No current is applied to the inactive coils, coils that are not within the magnetic field of the magnets of the magnet array **[22] 24**. Thus, all coils that are wholly or partially within the magnetic filed of the magnet array **24** are utilized to generate forces to control the stage in six degrees of freedom.

Page 17, the paragraph beginning on line 25:

(Amended) To achieve six degree of freedom control of the moving magnet motor, the coils need to generate forces in the X, Y, Z directions. As is evident, forces in the X, Y, and Z directions **[provides] provide** linear control and movement in the X, Y, and Z directions. These forces can also generate torques about the X, Y, and Z axes,

since there are multiple coils at different X, Y positions. For example, two coils separated in the X direction can produce different amounts of Z force to create a torque about the Y axis.[.]

Page 28, the paragraph beginning on line 13 and bridging pages 28 and 29:

(Amended) The method of the invention for independently controlling the forces and torque generated by the electric motor in six degrees of freedom preferably includes determining the uncompensated torque about the X, Y, and Z axis generated from the commutation scheme using the desired force vector \mathbf{R} and then determining the correction terms Δ_x , Δ_y , Δ_z that make the total torque equal the desired value. The uncompensated torque about the X, Y, and Z axis generated from the commutation scheme may be determined using force vector terms R_x , R_y , R_z and the lower-left nine elements of matrix \mathbf{A} . The correction terms Δ_x , Δ_y , Δ_z may be determined by dividing the desired torque minus the uncompensated torque about the X, Y, and Z axis by $[6i] - 6\pi$. The torque-compensated commutation equations thus [uses] use the terms R_x , R_y , R_z , Δ_x , Δ_y , and Δ_z .

Page 30, the paragraph beginning on line 28 and bridging pages 30 and 31:

(Amended) The illumination system includes an illumination source **851** and an illumination optical assembly **852**. The illumination source **851** emits a beam (irradiation) of light energy. The illumination optical assembly **852** guides the beam of light energy from the illumination source **851** to the optical assembly **804**. The beam

illuminates selectively different portions of the reticle **806** and exposes the wafer **808**. In [Figure 8] **FIG. 11**, the illumination system **802** is illustrated as being supported above the reticle stage assembly **810**. However, the illumination system **802** is secured to one of the sides of the frames and the energy beam from the illumination source **851** is directed to above the reticle stage assembly **810** with the illumination optical assembly **852**.

Page 31, the paragraph beginning on line 11:

(Amended) The reticle stage assembly **810** holds and positions the reticle **806** relative to the optical assembly **804** and the wafer **808**. Similarly, the wafer stage assembly **820** holds and positions the wafer **808** with respect to the projected image of the illuminated portions of the reticle **806** in the operation area. In [Figure 8] **FIG. 11**, the wafer stage assembly **820** utilizes the moving magnet electric motor **812** having features of the present invention. Depending upon the design, the lithography system **800** can also include additional wafer stage assemblies **820** to increase the throughput of the lithography system **800**.

Amendments to the Claims:

1. (Amended) A method for controlling a planar electric motor comprising a magnet array having [a] magnets with magnetic fields and a coil array comprising coils generally disposed in a plane, for positioning in six degrees of freedom, comprising:

determining currents to be applied to coils to generate forces between the magnet array and the coil array in first, second and third directions, the first and second directions lying in the plane and being generally orthogonal to each other and the third direction being generally orthogonal to the first and second directions;

determining resultant torques about the first, second and third directions between the magnet array and the coil array, which would be generated by the forces generated by the determined currents;

determining current adjustments to compensate for the resultant torques such that torques about the first, second, and third directions become desired values while the forces in the first, second, and third directions remain the same; and

applying a sum of the determined currents and determined current adjustments to the coils to interact with the magnetic fields of the magnet array to control the planar electric motor.

3. (Amended) The method of claim 1, wherein the currents to be applied to coils in [the] a portion of the coil array within the magnetic fields of the magnet array are sinusoidal, triangular or square waveforms.

6. (Amended) The method of claim 1, wherein the currents to be applied to the coils [is] are determined only for coils in a predetermined portion of the coil array.

9. (Amended) The method of claim 1, wherein the coils in [the] a portion of the coil array within the magnetic fields of the magnet array comprise [comprises] twenty-five or fewer coils.

10. (Amended) The method of claim 1, wherein the coils in [the] a portion of the coil array within the magnetic fields of the magnet array comprise [comprises] twelve or more coils.

11. (Amended) The method of claim 1, wherein the coils in [the] a portion of the coil array within the magnetic fields of the magnet array comprise [comprises] sixteen or more coils.

12. (Amended) A method for determining current to be applied to control a planar electric motor in six degrees of freedom, the motor having a magnet array and a coil array having coils generally disposed in a plane, comprising:

determining currents to be applied to coils for generating forces between the magnet array and the coil array in first, second, and third directions, the first and second directions lying in the plane and being generally orthogonal to each other and the third direction being generally orthogonal to the first and second directions, the currents being dependent upon the position of the magnet array and desired forces in the first, second, and third directions [or about the first, second, and third directions];

determining resultant torques, which would be generated by the determined currents; and

determining current adjustments to be added to the determined currents to compensate for the resultant toques such that torques about the first, second, and third directions become desired values while the forces in the first, second, and third directions remain equal to the desired forces.

15. (Amended) The method of claim 14, wherein the coils in the portion of the coil array include coils partially within the magnetic [fields] field of the magnet array.

16. (Amended) The method of claim 12, wherein the step of determining the currents to be applied to the coils comprises determining the currents to be applied to twenty-five or fewer coils.

17. (Amended) The method of claim 12, wherein the step of determining the currents to be applied to the coils comprises [comprising] determining the currents to be applied to twelve or more coils.

18. (Amended) A method for positioning an object in a lithography system, comprising:

providing a frame;

providing a stage for supporting the object and movable to position the object relative to the frame in six degrees of freedom;

providing a coil array attached to the frame, the coil array having coils;

providing a magnet array adjacent a portion of the coil array, the magnet array being attached to the stage and having magnets generally disposed in a plane, the plane defining [a] first and second [direction] directions and a third direction being generally orthogonal to the plane;

determining currents to be applied to coils in the portion of coil array to generate forces between the magnet array and the coil array in the first, second, and third directions;

determining a resultant torque between the magnet array and the coil array, which would be generated by the forces;

determining current adjustments to compensate for the resultant torque such that a torque between the magnet array and the coil array becomes a desired value while the forces in the first, second, and third directions remain the same; and

applying a sum of the determined currents and determined current adjustments to the coils to interact with magnetic fields of the magnet array.

19. (Amended) The method of claim 18, further comprising determining a position of the magnet array relative to the coil array and using the position of the magnet array in determining the currents, resultant torque or current adjustments.

20. (Amended) The method of claim 18, wherein the currents to be applied to coils in the portion of the coil array are sinusoidal, triangular or square waveforms.

23. (Amended) The method of claim 18, wherein the currents to be applied to the coils are determined only for coils in the portion of the coil array.

29. (Amended) A method for determining current to be applied to control a planar electric motor in six degrees of freedom, the motor having a magnet array and a coil array having coils generally disposed in a plane, comprising:

determining a position of the magnet array relative to the coil array in [the] X, Y, and Z directions, the X and Y directions being defined by the plane and the Z direction being generally orthogonal to the X and Y directions;

determining desired forces R_x , R_y , and R_z in the X, Y, and Z directions, respectively, for independently controlling the magnet array to move relative to the coil array in the X, Y, and Z directions [or about the X, Y, and Z directions];

determining currents to be applied to the coils for generating the desired forces R_x , R_y , and R_z between the magnet array and the coil array;

determining a resultant torque, which would be generated by the currents according to the position of the magnet array relative to the coil array and [to] the desired forces R_x , R_y , and R_z ; and

determining current corrections Δ_x , Δ_y , and Δ_z to be added to the currents, to produce desired torques T_x , T_y , and T_z about the X, Y, and Z directions]; wherein

resultant the] while forces F_x , F_y , and F_z in the X, Y, and Z directions [are] remain equal to the desired forces R_x , R_y , and R_z], and the resultant torques T_x , T_y , T_z equal desired values].

32. (Amended) A planar motor comprising:

a first member;

a second member [that interacts] interacting with the first member to generate driving force, the second member being movable relative to the first member in six degrees of freedom including [a] first, second, and third directions by the driving force; and

a controller connected to at least one of the first [member] and second [member] members, the controller determining information related to resultant [torque] torques about the first, second, and third directions between the first member and the second member, which would be generated by the driving force, the controller determining adjustment information to compensate for the resultant torques such that torques about the first, second, and third directions become desired values while the driving force remains the same.

33. (Amended) The planar motor of claim 32, further comprising a measuring system connected to the controller, the measuring system detecting information related to the relative position between the first member and the second member; and wherein

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the controller determines the resultant [torque] torques based on the information related to the relative position between the first member and the second member.

35. (Amended) The planar motor of claim [34] 32, wherein the controller outputs the adjustment information to at least one of the first [member] and second [member] members [to generate force for compensation of the resultant torque].

37. (Amended) The planar motor of claim 32, wherein the first member includes a magnet array having magnets and the second member includes a coil array having coils generally disposed in a plane, the plane defining [a] the first and second [direction] directions [and the direction of the driving force is substantially the same as the first and second direction].

38. (Amended) The planar motor of claim 37, wherein the adjustment information includes current adjustment information [the controller determines current adjustment to compensate for the resultant torque].

42. (Amended) A wafer on which an image [has] is formed by the lithography system of claim 40.

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